

Measuring the Benefits of Unilateral Trade Liberalization

Part I: Static Models

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T*he ultimate object of interest is not the outcomes the model produces but how those outcomes affect society's welfare.*

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Advocates of free trade in the Americas may have been disappointed last year when the U.S. Congress denied the president fast-track authority to pursue trade agreements with other nations. The main concern of free trade advocates is that this decision will halt, and even reverse, the trend toward free trade initiated in the Americas in the 1980s. This frustration would be particularly justified if countries in the region would benefit from mutual trade concessions but not from a unilateral move to free trade.

Should countries pursue free trade policies even when their trading partners do not? Readers familiar with Ricardo's celebrated comparative advantage theory of international trade would probably say yes.¹ However, contemporary models of international trade do not warrant such a clear-cut conclusion. This is the first of two articles that examine the reasons behind this ambiguity.

This first article examines the welfare gains from unilateral trade liberalization suggested by static models of international trade. The second article will study the welfare gains from unilateral trade liberalization predicted by the more realistic (but also more complicated) dynamic models.²

A survey of the literature reveals that models predicting that unilateral free trade will be harmful to societies rely on a common assumption whose empirical and theoretical foundations have not been convincingly substantiated. Thus, I conclude that, on balance, the arguments in favor of a unilateral move to free trade are stronger than those against it.

QUANTIFYING THE BENEFITS FROM FREE TRADE

Researchers trying to quantify the effect of tariff changes on international trade do so in what seems a logical way: they choose a state-of-the-art theoretical model deemed appropriate for the case under study, assign values to the model's parameters and variables, and measure its quantitative performance under various trade policies.

This was essentially the strategy used to evaluate the benefits of the North American Free Trade Agreement (NAFTA) for all countries involved. The so-called general equilibrium models of trade were the state of the art at that time. The qualifier "general" differentiates these models from a previous vintage of "partial" equilibrium models, which assume prices in some markets are given and somehow determined outside the model.

For example, in analyzing the effects of tariffs, many partial equilibrium models assume

real wages are fixed. This is highly unrealistic because tariffs usually alter the demand for factors of production by the industry or sector being protected, which in turn is likely to affect the relative prices of labor and/or capital. General equilibrium models, instead, allow for these effects because prices and quantities are determined endogenously, that is, within the model.

Theoretical General Equilibrium Models

The first element necessary in evaluating the benefits from unilateral trade liberalization is an appropriate general equilibrium model. General equilibrium models attempt to mimic as closely as possible actual economies by constructing an artificial (or model) economy the researcher can experiment with on the computer. This artificial economy is an abstract mathematical representation of the environment in which relevant economic agents are thought to operate and of the decision process by which those agents are thought to make their choices of consumption of different goods, of accumulation of capital, and so on. Methodologically, this implies that any general equilibrium model must start by specifying endowments, preferences, and technology.

The specification of preferences is an important step in formulating a general equilibrium model because the ultimate object of interest is not the outcomes the model produces but how those outcomes affect society's welfare.

For example, a reduction of tariffs on capital goods from x percent to y percent may double the rate of investment. The resulting increase in the capital stock will bring about higher growth, making it tempting to conclude that this higher growth will benefit society. However, accumulation of capital requires saving, which necessarily takes place at the expense of current consumption. If it were true that societies are always better off with faster growth, governments throughout the world could readily gather the necessary political support to adopt draconian measures reducing consumption by up to 50 percent. As history has proved, such a Stalinist approach to growth is doomed because it will be resisted by current generations, the ones who have to pay for that future growth with a drastic reduction in their consumption.

It is not a given, therefore, that the benefits of a reform (be it a trade reform or a tax reform) should be measured by the additional growth eventually made possible by the reform. Clearly, it would be preferable to measure those

benefits in terms of the additional well-being the reform brings about. Such a task requires the construction of an index of well-being, or welfare, with some ideal properties. Unfortunately, construction of such an ideal index is impossible, as Nobel Prize recipient Kenneth J. Arrow (1951) demonstrates in his celebrated impossibility theorem. Yet economists are asked to evaluate the costs and benefits of a reform and, therefore, must provide a connection between observable outcomes (such as investment, growth, or consumption) and some measure of well-being, however imperfect or debatable.

General equilibrium models assume the welfare of a typical household provides a good approximation to social welfare. Such an approach implicitly assumes all households and consumers have well-defined preferences over different economic outcomes and that such preferences have a mathematical representation; that is, they can be measured by some utility function. Usually, this utility function is assumed to depend on the quantity of goods and services households consume. The functional form assumed for the utility functions is not completely arbitrary. It is in part dictated by restrictions imposed by basic axioms of consumer theory. One such restriction is that consumers always prefer to have something of *every* good rather than a lot of some goods and nothing of others.³ In addition, a standard assumption is that preferences and the utility function that represents them are identical across households. This assumption guarantees that the utility function of any household adequately summarizes the welfare of all households.

A general equilibrium model exploits these assumptions by proposing that the representative household of a given country derives welfare from consuming, for example, the only good produced and exported by the country (c_1) as well as from consuming the only good imported by the country (c_2) and that the welfare this representative consumer obtains from different bundles of these goods can be measured by a welfare or utility function such as

$$(1) \quad \text{Welfare of representative consumer} \\ = \alpha_1 \log c_1 + \alpha_2 \log c_2,$$

where α_1 and α_2 are parameters that measure the relative importance the representative consumer attaches to each good in his preferences.

Given the focus of this article, it is worthwhile to note that the level of tariffs does not appear explicitly in Equation 1. Changes in tariffs, such as those during trade liberalizations,

appear only indirectly in the welfare function, to the extent that they induce changes in the outcomes (such as the consumption level) over which consumers define their preferences.⁴

Another important element in the abstract construct of general equilibrium models is the postulate that economic agents act purposefully to achieve the ends they seek. Consistent with this methodological approach, households are assumed to maximize their level of welfare, or utility (as measured by the utility function), subject to the limitation imposed by their income or budget constraint. The budget constraint is a mathematical representation of the common-sense principle that households cannot spend more than their revenues from all sources (capital and labor income, savings carried over from the past, credit).

The consumer's maximization problem described above is not trivial because consumers can purchase different consumption bundles with their available income, but not all those bundles deliver the same level of utility. The solution to the problem requires finding the consumption bundle that allows the consumer to achieve the maximum possible welfare at given prices. Solving the problem repeatedly for different prices usually delivers well-defined demand functions—the standard, textbook, downward-sloping demand curve for each good. (For a more formal presentation, see the box titled “The Decision Problem of Consumers and Firms in General Equilibrium Models.”)

Notice that changes in tariffs will generally change the prices of the goods from which consumers obtain utility. The price changes will alter the budget constraint, which may in turn change not only the consumption bundle that maximizes welfare but the level of welfare itself. That eventual shift in welfare induced by changes in tariffs is what general equilibrium models seek to measure.

A partial equilibrium model would stop the analysis here, in what could be referred to as the consumers', or demand, side of the economy. However, the endogenous determination of equilibrium prices, which result from the interaction of supply and demand, is in the very nature of general equilibrium models. Therefore, general equilibrium models must specify the suppliers', or production, side of the economy as well.

To that end, firms are assumed to combine primary factors of production (labor and capital) to maximize their profits. The transformation of these factors into output takes place according to some technology, mathematically represented by a production function.

Unfortunately, an issue of controversy among economists is whether production functions are characterized by constant returns to scale or increasing returns to scale. A 20 percent increase of all inputs results in a 20 percent increase in output under constant returns to scale but in a, say, 30 percent expansion of output under increasing returns to scale. The controversy is relevant to welfare gains from free trade because such gains tend to be larger under increasing returns to scale (see the box titled “The Decision Problem of Consumers and Firms in General Equilibrium Models”).

General equilibrium models connect the household and firm sectors of the economy by exploiting the fact that households are the ultimate owners of the factors of production—labor and capital—and, therefore, the ultimate recipients of the factor payments and profits the firms make.

Finally, the international link in general equilibrium models of international trade is provided by assuming each country exports those goods for which domestic output exceeds domestic consumption. The model is one of general equilibrium in the sense explained earlier, that prices are set endogenously at the level necessary to ensure the quantities supplied and demanded of all goods, services, and factors are equal.

Applied General Equilibrium Models

Applied general equilibrium models attempt to exploit the theoretical framework offered by general equilibrium models to answer specific quantitative questions such as what the welfare gains are from a particular trade agreement (such as NAFTA) or from unilateral trade liberalizations. A theoretical general equilibrium model is brought down to earth by assigning concrete values, for example, to the parameters α_1 and α_2 in Equation 1.

Another difference between theoretical general equilibrium models and applied ones is in the number of economic sectors they can handle. Theoretical models are concerned with analytical and general results, which are almost impossible to derive in a large model. By contrast, applied models are more interested in quantitative answers to specific problems and situations. Free from the obligation to deliver general results and theorems, applied general equilibrium models can specify a large number of economic sectors, as many as necessary to accomplish the desired level of realism, the only limitation being the computational ability to solve the model numerically.⁵

The Decision Problem of Consumers and Firms in General Equilibrium Models

Any general equilibrium model that attempts to measure the impact of trade policies on welfare must start by postulating the utility, or welfare, function of the representative household populating the artificial, or model, economy.

For example, Harris (1984) proposed to evaluate the welfare effects of trade liberalization according to the following utility, or social welfare, function:

$$(B.1) \quad \text{Welfare} = \sum_i \alpha_i \log c_i,$$

where c_i is the real consumption of good i and the summation is over all goods i , and α_i is a parameter that measures the importance of good i in households' preferences.

General equilibrium models postulate that economic agents act purposefully to achieve the ends they seek. Hence, households are assumed to maximize their level of welfare, or utility (as measured by the utility function), subject to a budget constraint.

In Harris' study, the representative household is endowed with an exogenous real income I . The consumer's problem can be represented, in the abstraction of a general equilibrium model, as the problem of maximizing Equation B.1 subject to the budget constraint

$$\sum_i p_i c_i \leq I,$$

which says that the sum of the price (in real terms) times the quantity purchased of each good (total expenditures) over all goods should not exceed total real income I .¹

Several consumption bundles will satisfy the budget constraint above, but only one will maximize the preferences, or welfare, given by Equation B.1. The consumer's decision problem consists of finding such a bundle. In this example, a standard first-order-conditions approach delivers the answer mathematically.

Notice that removal of international trade tariffs will generally change prices and thus the budget constraint and optimal consumption bundle. Through this channel the imposition or removal of tariffs affects welfare in general equilibrium models.

Recall that, in this type of model, prices are not taken as coming from outside the model but rather determined inside the model from the interaction of supply and demand. The demand side of the economy is characterized by the consumer's maximization problem just described, while the supply, or production, side is characterized by the firm's maximization problem described below.

General equilibrium models assume that firms combine primary factors of production (labor and capital) to maximize their profits. The transformation of capital and labor into output takes place according to some technology, mathematically represented by a production function.

To this end, the profits of a typical firm (or industry) i are represented mathematically as

$$\text{Profits} = p_i y_i - w l_i - r k_i,$$

where $p_i y_i$ represents the firm's revenues (from

selling a quantity y_i of good i at real price p_i) and the second and third terms are the costs of producing output y_i , where $w l_i$ represents the labor costs associated with hiring l_i hours of labor at the hourly real wage w and $r k_i$ the cost of renting k_i units of capital at the rental price r .²

The technological constraint, in turn, is represented as

$$\text{Output of firm } i = y_i = F(l_i, k_i),$$

where F is some function of l_i and k_i . As explained in the text, the nature of that function is a controversial issue. In particular, there is disagreement as to whether the production function F of the typical firm is characterized by constant returns to scale or increasing returns to scale.

For example, a possible mathematical representation of the production function F is

$$\text{Output of firm } i = F(l_i, k_i) = A * l_i^{\gamma_1} * k_i^{\gamma_2},$$

where $A > 0$, k_i is the level of capital, l_i is the amount of labor input and $\gamma_1 > 0$ and $\gamma_2 > 0$ are parameters. When $\gamma_1 + \gamma_2 = 1$, the above production function is constant returns to scale, as the reader can verify by multiplying capital and labor by the same percentage increase x . In that case:

$$\begin{aligned} A * \left[\left(1 + \frac{x}{100} \right) * l_i \right]^{\gamma_1} * \left[\left(1 + \frac{x}{100} \right) * k_i \right]^{\gamma_2} \\ = \left(1 + \frac{x}{100} \right)^{\gamma_1} * \left(1 + \frac{x}{100} \right)^{\gamma_2} * A * l_i^{\gamma_1} * k_i^{\gamma_2} \\ = \left(1 + \frac{x}{100} \right)^{\gamma_1 + \gamma_2} * A * l_i^{\gamma_1} * k_i^{\gamma_2} = \left(1 + \frac{x}{100} \right) * A * l_i^{\gamma_1} * k_i^{\gamma_2}, \end{aligned}$$

which says increasing each input by x percent results in an increased output of also x percent.

Note, however, that with $\gamma_1 + \gamma_2 > 1$, this same production function becomes increasing returns to scale: an increase of x percent in each input results in a larger proportional increase of output—specifically, in an increase of

$$\left(1 + \frac{x}{100} \right)^{(\gamma_1 + \gamma_2)} > 1 + \frac{x}{100}.$$

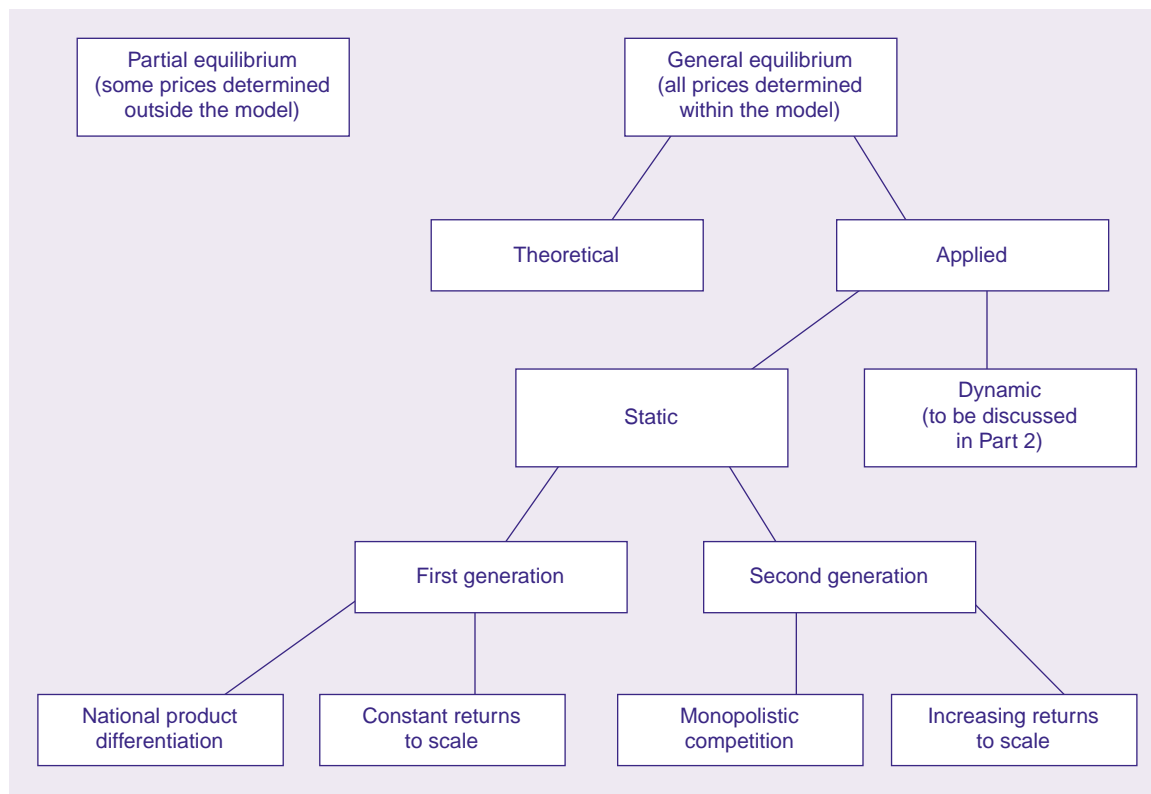
Unfortunately, theoretical considerations do not permit exclusion of either case, and the empirical evidence is mixed. This is somewhat problematic because, as stated in the text, gains from free trade tend to be larger under increasing than under constant returns to scale.

Finally, note that in general equilibrium models the household and firm sectors are connected because households' real income I (the right-hand side of their budget constraint) is nothing but the sum of the firms' profits and their payments to labor and capital inputs.

¹ Implicitly, all nominal quantities (prices and income) are being deflated by a common price index P .

² The rental price of capital, r , is generally given by the sum of the real interest rate and the depreciation rate.

Figure 1
Models of International Trade



Once the researcher has defined the utility function, the production functions, the number of sectors to be considered, and concrete values for the relevant parameters, it is possible to quantify the impact of a policy change by computing the model for different trade policies. The different policies' impact on welfare is then analyzed by reporting, for example, that in the artificial economy the welfare gains after the policy change are such that GDP should be x percent higher to achieve that same welfare without a reform. This measure is often referred to as the equivalent variation in income.

Different applied general equilibrium models give different qualitative answers to the question of whether unilateral free trade is a wise policy. These differences extend to the quantitative importance of the welfare gains or losses from such a move. The remainder of this article examines the details of the models responsible for those discrepancies.

STATIC APPLIED GENERAL EQUILIBRIUM MODELS OF FREE TRADE

Static applied general equilibrium models ignore the time dimension. The artificial econo-

mies of these models have no past or present and, therefore, no incentive to save or lend. As a consequence, countries cannot run a current account balance or trade deficit.

For purposes of exposition, and following the classification Brown (1992) proposed, the static applied general equilibrium models of unilateral trade liberalization can be grouped into two categories: first- and second-generation (*Figure 1*). First-generation models have in common two assumptions: the national product differentiation assumption and the constant-returns-to-scale assumption. The second-generation models replace the national product differentiation assumption with the monopolistic competition assumption, and the constant-returns-to-scale assumption with the increasing-returns-to-scale assumption. The remainder of this section analyzes how those assumptions affect the different welfare results from unilateral trade liberalization delivered by those models.

The Role of the National Product Differentiation and Constant-Returns-to-Scale Assumptions

Because their focus is empirical rather than analytical, applied general equilibrium models must be able to interpret actual data as

reported in official or private statistics. Unfortunately, available data are often not the exact empirical counterpart of a concept or definition used in the theoretical model. This discrepancy may force a compromise between theory and reality that can weaken confidence in the empirical results of a model.

In the case of international trade, researchers formulating theoretical models would like to make the sensible assumption that consumers don't discriminate goods by their origin. In other words, consumers value a good supplied by one country as much as the same good produced by another country. The assumption that a good is a perfect substitute in demand across origins seems natural in any model dealing with international trade. One empirical implication of this perfect-substitution assumption is that countries will import goods different from those they export, because countries typically export their production surplus after satisfying domestic demand for the good.

Under this perfect-substitution assumption we shouldn't see, as we do, trade statistics reporting that Germany and Japan import *and* export cars. Actually, the cars Germany imports differ from those it exports. Germany may export BMWs to Japan and import Hondas or Toyotas from Japan. Less obvious distinctions can be made as well. For example, a country may export two-door cars and import four-door cars; it may import cars with sunroofs and export cars without them, and so on. However, because such details are lost in trade statistics, it may appear as if countries import and export the same kind of goods. This seemingly puzzling situation, known among international trade scholars as the cross-hauling problem, occurs not because the perfect-substitution assumption is unrealistic but because of the way trade data are recorded. There are hundreds, perhaps thousands, of varieties of cars, and trade statistics should report, strictly speaking, exports and imports for each of them. But processing the information in such detail would be costly; in practice, many kinds of cars are grouped under broad categories. This renders impractical theoretical models based on the perfect-substitution assumption.

On the other hand, the nature of the problem suggests the way around it. If trade statistics fail to recognize that a good being imported is not actually the same as the good being exported, the solution is to assume that goods reported as both exported and imported are really different. In other words, the solution is to assume goods differ not only by type but also

by origin. This means, following our example, that cars produced abroad are not the same as cars produced domestically, which is a rather ingenious way to distinguish the BMWs Germany exports from the Toyotas Germany imports. This is the national product differentiation assumption adopted by the first generation of applied general equilibrium models.⁶

The national product differentiation assumption implies that the goods produced by each country are unique and, therefore, cannot be perfectly substituted by any of the goods produced by any other country. Although this assumption solves the problem of the lack of correspondence between data and theory otherwise present with the assumption of perfect substitution of goods across origins, it introduces a new problem: now countries have monopoly power over the goods they produce. The reason, of course, is that no other country can produce the same good. In the logic of this assumption, in a world where there are n products and m countries, there will be $n*m$ goods.

Most first-generation applied general equilibrium models of international trade combine the national product differentiation assumption with a constant-returns-to-scale technology. The combination of these two assumptions has serious theoretical and quantitative implications for the analysis of trade liberalization because, in the presence of market power, only imposing tariffs—not reducing them—improves a country's welfare.

The assumption of constant returns to scale is important because it keeps the market power at the country rather than at the firm level. Under constant returns to scale, the marginal cost is constant, independent of the level of production. Therefore, all firms will supply their outputs at a price equal to the constant marginal cost. Any attempt by an individual firm to set a higher price will divert its customers to competitors. Of course, no firm will set prices below marginal cost because it would be producing at a loss. None of the firms can, individually, exploit the market power implicit in the fact that no other country can produce the same products they do. Thus, the government can intervene by coordinating the firms' actions to enable them to exploit their market power. For instance, the imposition of a tax (tariff) on foreign goods will increase the domestic price of imports relative to the domestically produced—and eventually also exported—good. The lower relative price of the domestic good will induce more consumption of it and less of the imported good, producing two effects. On the one hand,

it will reduce the demand for the foreign good by the tariff-imposing country and, therefore, generate downward pressure on the world price of that good. On the other hand, it will reduce the surplus of the domestic good available for export to world markets, which will increase the international price of the good. This implies that the terms of trade—that is, the international price of exports relative to that of imports—shift in favor of the tariff-imposing country. (For a more detailed explanation of this result, see the box titled “Optimal Tariff Under the National Product Differentiation Assumption.”)

Reversing the argument, the unilateral removal of a tariff can worsen the terms of trade and be welfare-reducing, especially if the tariff had been at the level at which a country exploits its market power the most.

Welfare Gains from Unilateral Trade Liberalization in First-Generation Applied General Equilibrium Models

The few static applied general equilibrium models that have attempted to measure the gains of unilateral trade liberalization for a small country have indeed found negligible, or even negative, welfare gains from a unilateral move to free trade. Boadway and Treddenick (1978) found that removal of tariffs in Canada would cause welfare to decline by about 1 percent or increase by only 0.06 percent. The terms-of-trade deterioration resulting from an import tariff reduction, as implied by the national product differentiation assumption, has led Brown (1987) to conclude rather categorically that unilateral trade liberalization is rarely welfare-improving, even for a small country, in this first generation of static applied general equilibrium models.

It is important to remember, in evaluating those disappointing welfare results for the cause of free trade, that the motivation for the national product differentiation in first-generation applied general equilibrium models was mainly pragmatic, an apparently innocuous way to bridge the gap between theory and available data.⁷ However, this compromise may not appear as appealing when it becomes apparent that the assumption, in combination with constant returns to scale, implies that a country (not its industries) has complete monopoly power in the market for its exports and that this market power introduces a bias against trade liberalization. This bias would not be problematic if the market power implication of the national product differentiation assumption could be empirically validated, but this may not always be the case. These considerations led to the formula-

tion of second-generation static applied general equilibrium models, which replace the assumption of national product differentiation with the monopolistic competition assumption. The next section explains why second-generation models deliver somewhat higher welfare gains from unilateral trade liberalization.

The Role of Monopolistic Competition and Increasing Returns to Scale

To correct the country-monopoly-power side effect introduced by the national product differentiation assumption, many authors have replaced it with the assumption that each firm, rather than each country, produces a different product, transferring the monopoly power from the country to the firm level. This monopoly power is limited, however, by the fact that consumers can easily substitute the products of one firm with close varieties of the same good produced by another firm. Technically, each firm produces an imperfect-substitute good under monopolistic competition conditions.

Because each firm specializes in the production of a good no other firm can produce, the firm is able to exploit its market power on its own, without the help of an import tariff levied by the government. That is, firms exploit their market power as much as they can before any tariff is imposed. Consequently, the imposition of a tariff under monopolistic competition will be not only redundant but also, in general, detrimental to society. Not surprisingly, applied general equilibrium models relying on monopolistic competition will tend to find that unilateral removal of tariffs is welfare-improving.

The introduction of monopolistic competition in applied general equilibrium models solves the same problem the national product differentiation assumption does and at the same time avoids this assumption bias against unilateral trade liberalization. In particular, monopolistic competition can still account for the considerable cross-hauling observed in trade statistics. The puzzling observation that a country appears to export the same product it imports can be interpreted as a domestic firm producing (and exporting) a variety of the product different from the one being imported.

Unfortunately, the monopolistic competition assumption has a drawback the national product differentiation assumption does not have: it implies that each product variety will be produced by one and just one firm. This implication is problematic because it conflicts with the standard assumption of constant-returns-to-scale production technology.

Recall that a constant-returns-to-scale technology can deliver a given percentage change in the output of a good by simply changing all the inputs by that same percentage. This means any level of output Q_N of a certain good can be produced either by a single firm or by any number N of identical firms, each of them using $1/N$ fewer inputs than a single firm would to produce Q_N . In other words, under constant returns to scale the output of any firm can be replicated by N smaller and alike firms, yet this technologically natural possibility would be ruled out by the monopolistic competition assumption that each product can be produced by only one firm.

To save the contradiction of simultaneously assuming product differentiation and a constant-returns-to-scale technology at the firm level, most trade models appealing to monopolistic competition also assume the technology is increasing returns to scale. Equivalently, second-generation applied general equilibrium models of international trade assume the total production cost is composed of two parts: a fixed cost independent of the level of production and a variable cost proportional to the level of output.

In its simplest form, this assumption takes the mathematical representation

$$\text{Total cost} = F + bQ,$$

where F is the fixed cost and b the cost of an additional unit of output Q —that is, the marginal cost. Krugman (1979) uses this formulation to show how increasing returns to scale can account for international trade. What is important about this technological specification is that the *average* cost declines with the level of output. This can be seen easily by dividing the above equation by the level of output

$$\text{Average cost} = TC/Q = F/Q + b.$$

Since F is a fixed number, the ratio F/Q declines as Q , the level of output, increases, thus reducing overall average cost. This is exactly what one would expect from a technology under which a given percentage increase in inputs (and, therefore, in costs) delivers an even higher proportional increase in output.

The shape of the average cost curve of a hypothetical firm with an increasing-returns-to-scale technology is depicted in Figure 2, which also displays the hypothetical demand curve for the good produced by the hypothetical firm. The figure suggests one of the main implications of the increasing-returns-to-scale assump-

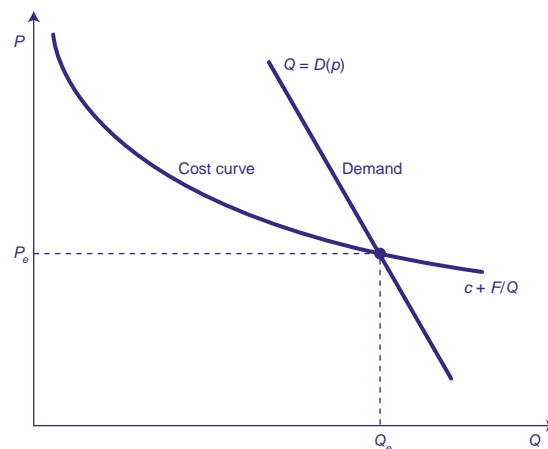
tion: only one firm will produce each good.

To see why, suppose the hypothetical firm of Figure 2 produces all output of a given good. The market equilibrium for that good will occur at the price P_e , where the firm will be able to satisfy the quantity demanded Q_e and at the same time cover the costs of doing so, since the price P_e equals the average cost at that level of output.

Now suppose N firms were going to supply the market. As in the case of constant returns to scale, each of them will operate at a lower scale than a single firm. But unlike in the constant-returns-to-scale case, the average cost for each of the firms will be higher than it would be for a single firm. This implies they would have to charge a higher price than the single firm would, that is, a price higher than P_e . Realizing this, at least one of these firms sooner or later will try to capture competitors' customers by cutting the price to P_e . Such a firm will be able to sustain this lower price without losing money because it will now supply the whole market, and under increasing returns to scale it will be able to produce that larger quantity at the lower average cost P_e .⁸

The prediction that just one firm will produce each good under increasing returns to scale is logically consistent with the monopolistic competition assumption that each good will be produced by only one firm. For this reason, second-generation applied general equilibrium models adopted the increasing-returns-to-scale assumption along with the monopolistic competition approach.

Figure 2
Increasing Returns to Scale and the Number of Firms



Optimal Tariff Under the National Product Differentiation Assumption

This box explains in more detail why the optimal tariff tends to be strictly positive in models of international trade that use the national production differentiation assumption when the production function at the firm level is assumed to be constant returns to scale.

To keep the discussion as nontechnical as possible, it will be presented in terms of standard graphical representations of the welfare function and budget constraint, although a more rigorous mathematical representation is possible and available in many advanced international trade textbooks.¹

Figure B.1 presents the standard two-dimensional representation of a welfare function such as that in Equation 1 in the text. Each of the curves in the figure traces the combinations of the quantities consumed of good 1 (c_1) and of good 2 (c_2) that allow the typical consumer of a given country (let's say the home country) to attain the same level of utility or welfare. For example, the curve labeled $U = 4.61$ represents the different pairs (c_1 , c_2) from which the consumer can derive a utility level of 4.61 when preferences are represented mathematically by Equation 1, with parameter values $\alpha_1 = \alpha_2 = 0.5$. The reader can verify, using Equation 1, that the same level of welfare can be attained with the consumption pairs $c_1 = 50$ and $c_2 = 200$, $c_1 = 100$ and $c_2 = 100$, or $c_1 = 200$ and $c_2 = 50$.

The straight line running from A to B in Figure B.1 is a geometric representation of the typical consumer's static budget constraint of the home country for the case of two goods. This line represents the different quantities c_1 and c_2 of each good the home country consumer can afford to buy when his income (in terms of good 1) equals A and the relative price of good 1 in terms of good 2 is 0.5. In what follows, and in line with the national product differentiation assumption, it will be assumed that the home country is the only world producer of good 1 and the foreign country is the only producer of good 2.

Now suppose the typical consumer of the home country is endowed with A units of good 1 and none of good 2. Because preferences are concave, meaning consumers have a taste for variety, the typical home country consumer would like some quantity of good 2 as well. However, according to the national product differentiation assumption, the home country is unable to produce good 2, so it is willing to trade part of its endowment of good 1 in exchange for some amount of good 2 produced by the

Figure B.1
Utility Maximization

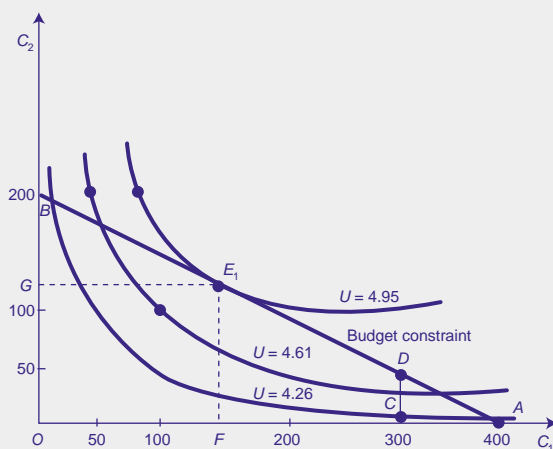
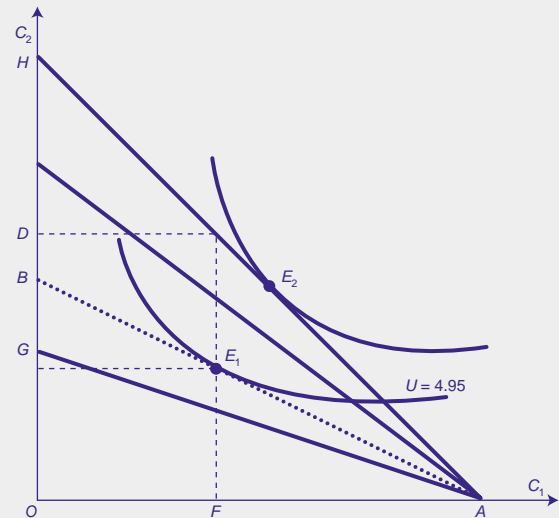


Figure B.2
Changes in Terms of Trade and Welfare



foreign country. When the relative price, or terms of trade, of the home good (export) in terms of the foreign good (import) is 0.5 as assumed, trade between the home and foreign country will take place at the ratio of one unit of good 1 for half a unit of good 2.² These particular terms of trade are represented in Figure B.1 by the slope of the budget constraint. This can be verified in the figure: when the typical home country consumer gives up consumption of 100 units of good 1, represented by the movement from A to C, the home country can export those 100 units to get in exchange 50 units of good 2, represented by the vertical distance $D - C$.

The home country consumers will keep trading good 1 for good 2 until they maximize their satisfaction or welfare, which will occur at point E_1 in the figure. Of all the combinations of c_1 and c_2 the consumer can afford with the budget AB, the one at point E_1 yields the highest level of welfare. This implies that the home country will consume the quantity F of good 1, export the quantity $A - F$ of that good—the excess of endowment of good 1 over the domestic consumption of good 1—and import the quantity G of good 2.

In the above example, the terms of trade were arbitrarily set at 0.5. But of course an entirely analogous analysis applies to any terms of trade. Figure B.2 represents a set of indifference curves along with several budget lines, each with a different slope and corresponding to different terms of trade. The dotted line represents the baseline case of the previous example in which the terms of trade were assumed to be 0.5. Budget lines above the dotted line represent improvements in the terms of trade for the home country with respect to the baseline case. For example, the budget line running from A to H has a slope of 1, which is greater than 0.5. At that budget line, the home country can trade each unit of the good it produces for one unit of the good it does not. This means the home country good (good 1) is now more valuable than before: it is worth as much as the imported good instead of only half, as it was when the terms of trade were 0.5. Of course, the home country consumers will benefit from the fact that the home good is more valuable relative to the foreign good. This improvement is reflected in that, with the new budget constraint AH, the optimal consumption of the typical home country household occurs at point E_2 ,

Optimal Tariff Under the National Product Differentiation Assumption (continued)

with a higher level of welfare than at E_1 , the point representing the welfare-maximizing consumption pair when the terms of trade were 0.5.

The above analysis suggests that a country can improve its situation if it can influence the terms of trade in its favor. The imposition of a tariff under the national product differentiation assumption can do just that. Under this assumption each country has market power over the goods it produces because no other country produces those goods.

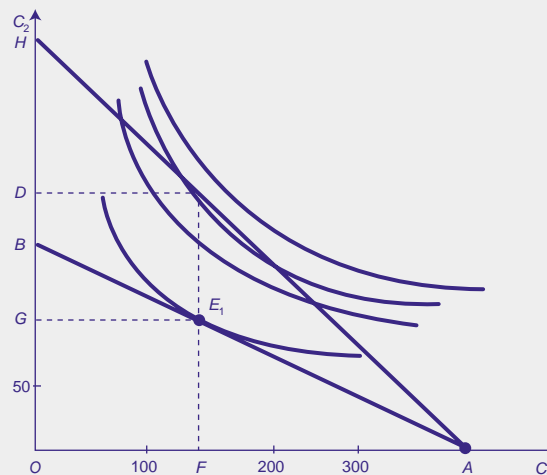
To see how a tariff can improve a country's situation, let's consider the baseline example when the terms of trade were 0.5. Now suppose the home country imposes a tariff of 50 percent on the imported good (good 2). For practical purposes, the imposition of a tariff implies that a certain amount of the imported good will have to be surrendered to customs officials. In this case, a tariff of 50 percent means that now each consumer will get 0.25 units of good 2 for each exported unit of good 1. The government will get to keep the remaining 0.25 unit. However, this analysis is valid only if the terms of trade remain the same after the imposition of the tariff, which is unlikely because the tariff makes the imported good more expensive relative to the home good for the home country consumers. They will consume less of the imported good and more of the exported good. The lower home country consumption of the imported good will put downward pressure on the world price of imports. Meanwhile, the higher domestic consumption of the home good will reduce the surplus of it available for export and put upward pressure on its international price. A fall in import prices and a rise in export prices will improve the terms of trade for the tariff-imposing country.

Suppose then that the imposition of a 50 percent tariff on good 2 by the country producing good 1 results in a 100 percent improvement in its terms of trade. In other words, suppose the terms of trade move from 0.5 to 1 as a result of the tariff. The new budget constraint implied by these new terms of trade for the home country consumers is represented in Figure B.3 by an outward movement of the budget line from AB to AH . At these new prices, the typical household of the home country will export $A - F$ units of good 1, receive in exchange D units of good 2, surrender half this amount, $D - G$, to customs, and keep the remaining half, G , for its own use. From the home country consumer's perspective, nothing has changed. He still receives half a unit of good 2 for each unit of good 1 he exports (or, equivalently, for each unit of good 1 he does not consume). The optimal consumption combination will still be represented by point E_1 , where the typical household attains the same level of welfare as before the imposition of the tariff.

It would appear, then, that imposing the tariff was a futile policy move. However, the country as a whole is richer because now the government has extra revenues, represented by import duties $D - G$ collected by customs. The government can use the additional income to upgrade public services. Or it can return the revenues to households in the form of higher pensions, social security benefits, or income tax reductions. The households, in turn, can use this tax rebate to increase purchases of both goods 1 and 2 and, therefore, to attain higher levels of utility than represented by point E_1 . The home country's welfare is improved after the tariff because the government successfully transfers the burden of the tariff to foreigners by altering the terms of trade against them.³

Of course, this example was designed to deliver welfare gains from a tariff. It is also possible that the terms-of-trade gain from a 50 percent tariff is too small to

Figure B.3
Welfare-improving Tariff



compensate the home country for the distortionary costs from a tariff. The ultimate benefit of a tariff depends on, among other things, the elasticities of demand for the home and foreign products both at home and abroad. The details are beyond the scope of this article; however, the interested reader is referred to Brown (1987), in which it is also argued that, empirically, most models using the national product differentiation assumption produce terms-of-trade gains strong enough to improve the welfare of the tariff-imposing country.

It may seem odd that a society can gain from imposing a tariff. After all, a tax on imports—like any other tax—is, in principle, welfare-decreasing. However, this outcome ignores the presence of an externality under the national product differentiation assumption: the country has a market power that its firms cannot exploit at an individual level when their production technology is constant returns to scale. This sort of externality justifies the government intervention. Under those circumstances, a tariff turns out to be corrective rather than distortive. By imposing a tariff, the government implicitly forces the home country firms and households to coordinate their actions to produce and consume, in the aggregate, the quantity of good 1 at which the home country exploits its market power the most.

The result that the optimal tariff is eventually positive will tend to disappear, therefore, in models that assume increasing returns to scale at the firm level or that abandon the national product differentiation assumption and its implicit market power. In the first case, as explained in the text, each firm will be able to exploit its market power on the differentiated good it produces, without the need for the government to step in. In the second case, many different countries will be producing each good; therefore, no individual country will have control over the market of any particular good. However, in face of the considerable amount of cross-hauling of goods across borders reported in international trade data, abandoning the national product differentiation assumption may be problematic for addressing some quantitative questions in international trade.

¹ See, for example, Grubel (1977), especially chap. 8, p. 155.

² These terms of trade imply that the good produced by the home country is worth, in dollar terms, half the price of good 2.

³ Notice that now the foreign country receives less for its exports and pays more for its imports.

Welfare Gains from Unilateral Trade Liberalization in Second-Generation Applied General Equilibrium Models

As previously explained, compared with national product differentiation, monopolistic competition is more favorable in principle to the case of free trade because in such an environment firms incorporate their market power in their price decisions, so no corrective government tariff is needed.

This intuition is rigorously confirmed by Harris (1984), who finds that welfare gains from unilateral trade liberalization are nil in the models with just national product differentiation and constant returns to scale, whereas they are in the range of 2.7 percent to 4.1 percent of GDP when some of the goods are produced under conditions of monopolistic competition and increasing returns to scale.

Although the gains from unilateral trade liberalization delivered by second-generation applied general equilibrium models are positive, they are far from staggering. After all, a gain in GDP of 3 percent to 4 percent is in the same order of magnitude as the normal annual GDP growth for many developed countries.

CONCLUSION

Static applied general equilibrium models fail to deliver the eye-popping gains from unilateral trade liberalization that free trade advocates often promise. As this conclusion applies to both first- and second-generation models, it appears to be rather robust to the significantly different assumptions about market structure or technology made by the two generations of static models.

However, static models are single-period models unable to incorporate the important dimension of time, ruling out savings and investment. Why should economic agents save and invest if there is no tomorrow? This is unfortunate in the context of trade liberalization because reductions of tariffs on, for example, capital goods, may induce more investment, which will increase capital stock and, hence, a society's ability to produce and consume more in the future. But static models—having neither past nor future—will leave out of the equation those welfare gains from larger future consumption, which can be far more important than any gains from larger present consumption. In fact, the omission of the time dimension may ultimately explain the negligible welfare gains from unilateral tariff reductions delivered by the static models examined in this first article. This is pre-

cisely the conjecture that will be more fully explored in the second article on this topic.

NOTES

- ¹ David Ricardo (1817) was the first economist to argue that free international trade would be beneficial to two countries even if one of them produced all traded goods more efficiently than the other. His key insight was that what makes international trade desirable is not this absolute advantage but the comparative or relative advantage—that is, the efficiency of each country at producing one good relative to its efficiency at producing other goods.
- ² Static models are those in which the dimension of time is missing. In such models there is no past or future: all analysis is conducted as if everything happened at one time. In contrast, dynamic models do incorporate the dimension of time in the analysis.
- ³ In economists' technical jargon, preferences are concave.
- ⁴ Notice also that the utility function given in Equation 1 satisfies the taste for variety mentioned in the text, in the sense that the consumer is always better off consuming a little of every good than a lot of one good and nothing of others. Demonstrated mathematically, the consumer would get an infinitely negative utility by consuming nothing of some good because in that case $\log 0 = -\infty$.
- ⁵ This is why applied general equilibrium models are also referred to in the literature as computable general equilibrium models.
- ⁶ Because Armington (1969) was the first to propose this assumption, it is often referred to in the literature as the Armington assumption.
- ⁷ Another reason for the introduction of the national product differentiation assumption is that slight changes in tariffs tend to produce unrealistically large moves toward specialization in models making the opposite assumption that products are homogeneous across countries (see Shoven and Whalley, 1984, p. 1035).
- ⁸ Readers familiar with the literature will recognize this argument as basically the contestable markets hypothesis often posed to question the effective market power of potential monopolies and their ability to depart too much from competitive outcomes.

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